UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

In re: Methyl Tertiary Butyl Ether ("MTBE") Products Liability Litigation	:	**Master File No. 1:00-1898** **MDL No. 1358 (SAS)** **M21-88**
This Document Relates To: *Orange County Water District v. Unocal Corporation, et al.*, Case No. 04 Civ. 4968 (SAS).	:	The Honorable Shira A. Scheindlin

DECLARATION OF DARRELL K. FAH IN FURTHER SUPPORT OF DEFENDANTS' MOTION FOR SUMMARY JUDGMENT BASED ON THE STATUTE OF LIMITATIONS

DECLARATION OF DARRELL K. FAH

I, Darrell K. Fah, hereby declare:

1. I am an Environmental Business Manager for Atlantic Richfield Company ("ARCO"), a BP-affiliated company (collectively "BP"), which is a defendant in this litigation. I have been an employee of ARCO and/or BP since March, 1997. Prior to joining ARCO, I had ten years of related experience in the retail petroleum industry in environmental consulting and remediation management. I have personal knowledge of the matters stated herein, and if called upon to testify, could and would competently do so.

2. Where BP carries out investigation and remediation activities at retail gasoline service stations in California as a responsible party, it does so subject to the oversight and directives of the Regional Water Quality Control Board and other local agencies, and also pursuant to guidance documents issued by such regulatory entities. BP works cooperatively with the responsible regulatory agency, and with full recognition of their statutory powers to direct the activities of a responsible party such as BP.

3. Under regulatory guidance documents and direct orders, a responsible party is required to conduct investigation, clean-up, and abatement activities through a progressive series of phases, adjusted as needed, to accommodate site-specific circumstances. The remediation of a release of gasoline and its constituents (including MTBE and TBA) constitutes an iterative process that includes, as core components, drilling soil borings, construction of monitoring wells, analysis of soil and groundwater samples from borings and monitoring wells, and a variety of remediation technologies used to remove or eliminate contaminants. Data from monitoring wells either on or off the station property are collected on an ongoing basis and are analyzed and relied

upon by BP, its environmental consultants, and the regulators overseeing activities at a particular station to determine the contours and characteristics of a gasoline release, and to evaluate what specific processes should be employed to remove or eliminate contaminants.

4. At each stage in this process, and whenever new information becomes available, BP, its consultants, and the regulators evaluate what additional or different actions, if any, may be required to remediate any contamination. Whenever new monitoring wells are installed, or new soil borings are taken, BP, its consultants, and the regulators evaluate the information thus obtained in making such decisions. In this way, each monitoring well installed, and the collection of sampling data from such well, constitutes a core part of the investigation and remedial activities being conducted at the site.

5. As new information becomes available, decisions to install additional monitoring wells or to institute different active remediation technology may be made years after an initial remediation program is commenced. As an example, ARCO #1887 (located at 16742 Beach Boulevard in Huntington Beach, California), which I understand to be part of Plaintiff Orange County Water District's ("the District") Focus Plume No. 1, has been undergoing active remediation for more than a decade. Recently, however, the initiation of a new remedial technology -- in-situ chemical oxidation (ISCO) -- was proposed in a Revised Conceptual Model and Corrective Action Plan submitted to Orange County Health Care Agency by BP's consultant on April 28, 2009. A copy is attached hereto as Exhibit 1. This new technology was proposed after analyzing seven (7) "progress borings" drilled at the site in January 2009. Based on the data from those borings, BP, in consultation with the oversight agency, has recommended that a different technology - in this case, ISCO - be implemented to address contamination attributable to the site. Both at ARCO #1887 specifically, and at all ARCO sites being addressed by the

regulatory agencies, data from borings and wells continue to be analyzed and assessed on an ongoing basis to ensure that appropriate clean-up measures are being employed.

6. I am aware that an employee of the District has suggested that a distinction can be drawn between monitoring wells installed "for the purpose of plume delineation" and those that "appear[] to be placed to detect MTBE escaping remediation." In my experience, such a distinction does not exist. Whenever any monitoring well is installed or sampled, the resulting data are used to evaluate the contours and characteristic of a gasoline release and to make decisions as to whether additional monitoring wells or different remediation technologies should be employed . When new information becomes available -- whether from a monitoring well installed on or off the station property or from other sources -- that indicates that a modification to the remediation measures being taken at the site is called for, appropriate action will be taken at any stage in the process.

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct and that this declaration was executed on June 16, 2009 at La Palma, California.

Darrell K. Fah

Exhibit 1

April 28, 2009

Ms. Geniece Higgins
Orange County Health Care Agency
Local Oversight Program
1241 East Dyer Road, Suite 120
Santa Ana, California 92705

Sent via FedEx

Subject: Quarterly Monitoring Report Submittal

Dear Ms. Higgins:

On behalf of Atlantic Richfield Company, Delta Consultants is submitting the enclosed *Revised Site Conceptual Model and Corrective Action Plan* prepared for the following ARCO Facility:

ARCO Facility No.	OCHCA Case No.	Location
1887	88UT121	16742 Beach Blvd., Huntington Beach

If you have any questions, please contact Darrell Fah of Atlantic Richfield Company at (714) 670-5228.

DELTA

Sincerely,

DELTA CONSULTANTS

Christopher A. Ota
Project Manager

Fabio M. Minervini
California Professional Geologist No 7861

Encl: Atlantic Richfield Company Quarterly Monitoring Report

cc: Mr. Darrell Fah, Atlantic Richfield Company (Enfos)
Ms. Valerie Jahn-Bull, CRWQCB-Santa Ana Region, Riverside, CA
Mr. Jay Dablow, Environmental Resources Management

a member of Inogen Environmental Alliance

SUSTAINABLE STRATEGIES FOR GLOBAL LEADERS

REVISED SITE CONCEPTUAL MODEL AND CORRECTIVE ACTION PLAN

ARCO Facility No. 1887
16742 Beach Boulevard
Huntington Beach, California
OCLOP Case No. 88UT121

April 28, 2009

DELTA

Prepared for:
Atlantic Richfield Company
4 Centerpointe Drive
La Palma, California 90623

Preparad by:

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ARCO Facility No. 1887
16742 Beach Boulevard
Huntington Beach, California
OCHCA Case No. 88UT121

1.0 INTRODUCTION

1.1 Purpose and Scope of Services

On behalf of Atlantic Richfield Company, a BP affiliated company, Delta Consultants (Delta) has prepared this Revised Site Conceptual Model and Corrective Action Plan (RSCM&CAP) for ARCO Facility No. 1887 (the site), located at 16742 Beach Boulevard in Huntington Beach, California (Figure 1). This RSCM&CAP was prepared in response to the request from the Orange County Health Care Agency (OCHCA) in a letter to Atlantic Richfield Company dated November 20, 2008 (Appendix A). The letter approved Delta's Work Plan for Remediation Progress Soil Borings dated October 16, 2008, and requested that the results of the progress assessment be included in the submittal of a Site Conceptual Model (SCM). In addition, the OCHCA letter requested that if the SCM indicated that the site assessment was completed, a Corrective Action Plan (CAP) be also included in the SCM. The objective of this RSCM&CAP is to describe current site conditions with respect to the hydrocarbon-impacted soil and groundwater beneath the site, to identify potential current and future receptors, and to recommend remedial action. This RSCM&CAP provides the results of the recent progress assessment, compiled with historical assessment data and current groundwater monitoring data, to present a revised conceptual model for the site and recommend a remedial approach.

Presented herein is a brief site description, the surrounding land use, a summary of previous investigations and remedial history, a description of the regional and site geology and hydrogeology, information on nearby wells and other potential conduits in the vicinity of the site, results of the recent progress assessment, the extent of impacted soil and groundwater beneath the site, summary of the SCM and its conclusions, and a revised CAP, which includes the preliminary results for the bench-scale feasibility test conducted at the site.

2.0 SITE DESCRIPTION AND LAND USE

2.1 Site Description

The site is located at 16742 Beach Boulevard, on the southeast corner of Beach Boulevard and Terry Drive in Huntington Beach, California (Figure 1). The site is a former ARCO retail gasoline service station. In April 1989, two 6,000-gallon and two 4,000-gallon underground storage tanks (USTs) were removed from the eastern portion of the site. These USTs were replaced with three 12,000-gallon USTs installed in the northwestern portion of the site. The fuel and waste-oil USTs, and associated dispensers and piping were permanently removed from the site in October 2001, during site decommissioning activities. Currently, the site is a vacant lot paved with asphalt. A site map showing the former locations of USTs and fuel dispensers is included as Figure 2.

2.2 Surrounding Land Use

The site is located in a primarily commercial area and is adjoined on the east and south property boundaries by the Beach Lincoln Mercury automobile dealership.

3.0 SUMMARY OF PREVIOUS ASSESSMENTS

Several phases of investigation and remediation have been completed at the site. To date, a total of fifty-four soil borings have been advanced to characterize adsorbed-phase hydrocarbons in soil and beneath the site. Ten of the borings were converted into vadose wells, for remediation purposes, and twenty-nine into groundwater monitoring wells, to characterize dissolved-phase hydrocarbons in groundwater beneath the site. From those borings, approximately 220 soil samples have been collected to assess the extent and presence of fuel-related hydrocarbons in soil beneath the site. An additional 32 soil samples were collected from beneath the two former fuel UST locations, former waste oil USTs, and former fuel dispenser and associated product line locations. Soil sample, boring, and well locations are shown on Figure 2. A summary of all historical soil sample analytical results is presented as Table 1 and the well construction details are presented on Table 2. The following narrative provides a general case history for the site based on all data available to Delta from December 1988 to April 2002. The most recent soil data from the progress borings advanced on January 14 and 15, 2009, is reported separately in Section 7.0 of this document.

In December 1988, Applied GeoSystems, Inc. (AGI) advanced four soil borings (B-1 through B-4). Soil borings B-2 and B-3 were advanced in the vicinity of the former USTs and boring B-4 was advanced in the future location of the new USTs on the northwest corner of the property. Boring B-1 was located southwest of the former USTs and was converted to groundwater monitoring well MW-1 (screened 5 to 30 feet below ground surface [bgs], Table 2)(AGI, 1989).

In April 1989, two 6,000-gallon and two 4,000-gallon gasoline USTs were removed from the eastern portion of the site. According to information provided by ARCO, the middle tank formerly contained gasoline but was no longer in use after having failed a pressure test. Results of laboratory analyses for five soil samples collected from beneath the former tank locations indicated total petroleum hydrocarbons as gasoline (TPHg) were detected at concentrations ranging from 163 to 12,582 milligrams per kilogram (mg/kg) (Table 1).

During the UST removal activities in April 1989, one waste-oil tank was also removed. Analytical results for the soil sample collected beneath the former waste-oil tank indicated a total recoverable petroleum hydrocarbon (TRPH) concentration of 20 mg/kg (Table 1).

Four soil samples were also collected during the excavation for the new USTs in the northwest corner of the site. Analytical results for the samples indicated the presence of impacted soil in the southern and eastern portions of the new tank cavity (TPHg concentrations up to 619 mg/kg, Table 1). Three new double-walled fiberglass USTs were installed on the northwest corner of the site (AGI, 1989).

In August 1989, AGI advanced 11 additional soil borings at the site. Borings B-5 through B-9 were installed south of the former USTs to investigate the lateral extent of soil impact associated with the former USTs. These borings were converted to vapor extraction wells and were screened from approximately 3 to 20 feet bgs. In order to evaluate the lateral extent of dissolved-phase hydrocarbon impact at the site, soil borings B-10 through B-15 were advanced and converted to groundwater monitoring wells MW-2 through MW-7 and were screened from 10 to approximately 25 to 30 feet bgs (AG, 1991).

In April 1990, AGI advanced soil borings B-16, B-17, B-18, and B-19 adjacent to groundwater monitoring wells MW-3, MW-4, MW-6, and MW-7 respectively. The borings were converted to groundwater monitoring wells MW-8, MW-9, MW-10, and MW-11 and were screened from between 25 to 49 feet bgs. In addition, groundwater monitoring well MW-1 was properly destroyed (AG, 1991).

In July 1991, RESNA Industries (RESNA) advanced soil borings B-20 and B-21. These borings were converted into vapor extraction wells. Wells B-20 and B-21 were screened from approximately 4 to 19 feet bgs to provide additional future extraction points in the vicinity of the

former and new USTs. Also in July 1991, groundwater monitoring well MW-12 was installed south of the western dispenser island and was screened from 23 to 43 feet bgs. The top portion of the screen interval of well MW-12 extended at least 6 feet into the lower portion of the silty clay unit (RESNA, 1993).

In October 1991, RESNA installed three additional downgradient groundwater monitoring wells south of the site (MW-13, MW-14, and MW-15). These wells were constructed with various screen lengths across both the silty clay unit and across the underlain sand (RESNA, 1993).

In June 1992, RESNA advanced four soil borings (B-26 through B-29) to assess the lateral extent of LPH in the southern portion of the site. The borings were subsequently converted to wells MW-16, B-27, B-28, and EW-1, respectively. LPH was noted in well B-27 (RESNA, 1993).

In August 1994, Brown and Caldwell (B&C) overdrilled and properly destroyed wells MW-16 and EW-1. Well MW-16 was screened within both the silty clay unit and within the sand unit. Due to suspicions that the packer installed to isolate the two water-bearing zones was ineffective, this well was destroyed (B&C, 1995a).

Also in August 1994, off-site groundwater monitoring wells MW-17 and MW-18 were installed south of the site. Wells MW-17 and MW-18 were screened from 15 to 25 feet bgs and from 40 to 45 feet bgs, respectively (RESNA, 1995a).

In December 1995, off-site groundwater monitoring wells BC-1 and BC-2 were installed to the west and east of the site, respectively. The wells were screened from approximately 10 to 25 feet bgs. In October 1996, groundwater monitoring wells BC-3 and BC-4 were installed and screened from approximately 10 to 25 feet bgs.

In July 2001, Delta conducted a vertical assessment to delineate the extent of hydrocarbons in soil beneath the site. This assessment included the advancement of 5 direct-push soil borings (B-31 through B-35) to total depth of approximately 50 feet bgs (Delta, 2001).

In late October 2001, ARCO initiated demolition activities at the site in preparation for the divestment of the property. On October 31 and November 1, 2001, Delta collected 22 soil samples under the direction of the OCHCA beneath the former USTs, fuel dispensers, and product piping.

In April 2002, Delta installed three groundwater monitoring wells (MW-19s, MW-20s, and B-36) screened in the upper water-bearing zone (screen interval extending from 5 to 25 feet bgs), and three groundwater monitoring wells (MW-10R, MW-19d, and MW-20d) screened in the lower water-bearing zone (screen interval extending from 34 to 44 bgs). Wells MW-19s and B-36 were connected to the soil vapor extraction (SVE) system.

Groundwater sampling has been conducted at the site since May 1990. Historical groundwater elevation data are presented in Table 3, and historical groundwater analytical results are presented in Tables 4 and 5. Data collected during the first quarter 2009 groundwater monitoring event conducted on February 6, 2009, indicate that the current maximum concentrations of dissolved TPHg, benzene, and methyl tertiary butyl ether (MTBE) (45,000, 12,000, and 7,500 micrograms per liter [μg/l], respectively) were detected in well BC-3; and the current maximum concentration of dissolved tertiary butanol (TBA) (24,000 μg/l) was detected in MW-6.

4.0 SOURCE REMOVAL AND REMEDIATION ACTIVITIES

4.1 Source Removal

In April 1989, two 6,000-gallon and two 4,000-gallon gasoline USTs were removed from the eastern portion of the site. All soil excavated from the former tank area was reused as backfill, following tank removal, for future in-situ remediation (AGI, 1989). In addition, one waste-oil tank was also removed in April 1989. Prior to the installation of a new waste-oil tank, approximately 35 cubic yards of impacted soil from the waste-oil tank excavation were removed from the site and properly disposed (AGI, 1989). During installation of new gasoline USTs in the northwest corner of the site, impacted soil was encountered. Approximately 65 cubic yards of soil from the new tank excavation were also removed from the site and properly disposed.

LPH was initially detected in monitoring well MW-1 (apparent thickness of over 3 feet) in April 1989 during UST removal activities. In October 1989, an LPH recovery system was installed in well MW-1. The recovery system operated in this well from October to December 1989 and recovered approximately 30 gallons of LPH. In December 1989, the LPH recovery system was moved to well MW-5 where it remained until April 1990. During this period, approximately 30 gallons of LPH were removed from well MW-5 (AGI, 1991).

LPH recovery efforts were continued by RESNA on wells B-7, B-9, B-27, MW-5, MW-12, MW-13, and MW-14 from February 1992 to June 1993. During this time, approximately 200 gallons of

LPH were recovered via hand bailing (RESNA, 1994a). From June 1993 to September 1995, no LPH was detected in any of the wells monitored quarterly. In September 1995 through May 1996, a sheen of LPH was noted in wells MW-5 and MW-14 and LPH recovery was conducted by B&C utilizing a vacuum truck. LPH was not detected again in groundwater wells at the site until March 2000. During the first, second, and third quarters 2000, a sheen of LPH was noted in wells MW-7, MW-12, MW-13, and MW-14. Measurable apparent thicknesses of LPH ranging from 0.03 to 0.80 feet have been measured in well MW-12 during 2001. From first quarter 1998, when Delta became ARCO's consultant for the site, until the 3rd quarter 2008, the LPH recovery program has consisted of using a vacuum truck to skim groundwater and accumulated LPH from each monitoring well during quarterly groundwater sampling events. Historical LPH recovery data available to Delta are presented in Table 6.

In October 2001, all the three gasoline USTs, the waste-oil UST, all eight fuel dispensers, and all product, ventilation, and vapor recovery piping were removed from the site. The site was demolished and the property was divested.

4.2 Remediation

In 1990, AGI conducted a limited SVE pilot test in the vicinity of the former USTs using well B-5. During this test, a radius of influence of approximately 29 feet was observed; however, based on the proximity of this well to the backfill soil within the former UST area, the radius of influence from this test may be overestimated (AG, 1991).

In August 1992, RESNA conducted an aquifer pumping test at the site using well EW-1. Well EW-1 was screened from 33 to 43 feet bgs within the lower sand unit, logged at this location as a well-graded, fine- to medium-grained very dense sand (SW). Results of the pump test indicated that the lower sand zone has a transmissivity of approximately 1.23 square feet per minute and a specific yield of 1 to 10 percent. The estimated limit of the steady state capture zone downgradient of the pumping well at a rate of 5 gallons per minute (gpm) was 88 feet. No drawdown of groundwater was noted in nearby wells B-27 or B-28, which are completed to a depth of 25 feet bgs within the silty clay unit (RESNA, 1993).

In early 1994, RESNA conducted an additional limited SVE pilot test using wells B-27 and B-28 (screened 10 to 25 feet bgs). The results of this test indicated SVE would not be a feasible method of soil remediation based on low air flow rates. However, static water levels in wells B-27 and B-

28 were approximately 15 feet bgs at the time of the pilot test, leaving a limited extraction screen length (RESNA, 1994b).

In May 1995, B&C conducted a dual-phase extraction (DPE) pilot test utilizing well B-7. Well B-7 is located approximately 15 feet south of the former USTs and is screened from approximately 3 to 20 feet bgs. During the test, groundwater and vapor were extracted simultaneously from well B-7. Groundwater was lowered approximately 8 feet at an average rate of 0.33 gpm. Flow rates of approximately 15 to 19 standard cubic feet per minute and extraction vacuums of 130 to 180 inches of water column were achieved. Based on induced vacuum measurements in nearby wells, a radius of influence of 15 feet was estimated (B&C, 1995b and 1995c).

On March 19, 1997, B&C initiated SVE activities at the site. The system consists of a Baker Furnace™ 200 thermal/catalytic oxidizer connected to a combination of seven groundwater and ten vadose wells. These 17 wells were divided into 3 groups and controlled by 3 separate manifolds (A, B, and C) within the treatment compound. Each well could be isolated by a valve located at the wellhead. Manifold A included wells P-2, B-5, B-6, B-7, B-8, and B-9. Manifold B included wells P-1, MW-3, MW-7, and B-20. Manifold C included wells MW-5, MW-6, B-21, B-27, MW-12, B-28, and MW-13. Historical remediation system performance data are presented in Table 7.

The SVE system operated for approximately seven months under a South Coast Air Quality Management District (SCAQMD) various locations permit. From March to October 1997, approximately 625 pounds of hydrocarbons were removed from the subsurface. During this period, a maximum influent TPHg concentration of 8,500 parts per million by volume (ppmv) was reported.

From October 1997 through February 1999, the system remained off pending SCAQMD application, public notification, and issuance of a fixed location permit. On May 6, 1999, following receipt of the permit, repair to the SVE system’s supplemental fuel source, and installation of a knock out water system, the Baker unit was restarted by Delta. In February 2000, Delta installed and connected well B-30 to the SVE system’s Manifold C. Well B-30 was installed south of the western dispenser island, adjacent to well MW-12.

From May 6, 1999 to June 6, 2001, the SVE system remained in continuous operation mode and operated at an average up time of approximately 93%. During this period of time the SVE system operated 17,063 hours and removed 3,816 pounds of hydrocarbon from the subsurface (Table 7).

The system was manually shutdown on June 6, 2001 in order to conduct system modifications in preparation for a 90-day DPE pilot test. On August 1, 2001, DPE pilot test activities were initiated with Bubblex™ stingers (used for groundwater extraction) installed in wells MW-7 and MW-13. The pilot test was conducted through October 29, 2001, when the system was shutdown for site demolition activities related to the divestment of the property. During the pilot test, approximately 720 pounds of hydrocarbons removed from the subsurface and 95,938 gallons of groundwater were extracted, treated, and discharged to the storm drain under an NPDES permit. On November 16, 2001, Tait Environmental (Tait) submitted a *Performance Report of 90-day Bubblex Two-Phase Extraction Test.* It is likely that the majority of the water recovered was extracted from well MW-13, which is screened in the lower water-bearing zone composed of sand.

In August 2002, a new NPDES permit was issued and DPE activities were restarted at the site. The new permit has significantly more stringent analytical requirements than the previous one. From September 18, 2002, through October 20, 2002, Tait conducted DPE . During this time approximately 867 pounds of hydrocarbons and 34,562 gallons of groundwater were removed from the subsurface. During the remainder of 2002 and the first half of 2003, the DPE system remained off for extensive repairs to the Baker™ thermal oxidizer (including the chart recorder, process blower, combustion blower, and electrical panel) and the groundwater extraction (GWE) and treatment system portion of the system (including re-piping and stinger adjustments to the well field, rebuilding of the knock-out sump for safety concerns, and re-piping of the groundwater transfer lines).

Following repairs, Delta restarted the DPE system on July 8, 2003. The system was connected via aboveground process piping to wells MW-7, MW-19S, B-5, B-27, B-28, B-30, B-36, and BC-3. Upon startup, all eight wells were open to the system (with approximately 10% dilution). Field measured flame-ionization detector (FID) readings collected from each of the eight wells ranged from 1,924 to 7,239 ppmv. A total system flow rate of 118 standard cubic feet per minute at 115 inches of water column was observed at re-startup. During re-startup, individual vapor samples were also collected from each of the eight extraction wells. Maximum TPHg, benzene, and MTBE concentrations of 3,400, 58, and 45 ppmv, respectively, were indicated in the vapor sample collected from well MW-19S (Table 8).

The DPE system is still currently operating, the GWE system focuses extraction on wells BC-3, B-27, B-28, and MW-6; and the SVE system focuses extraction on wells B-5, B-27, B-28, B-30, B-36,

BC-3, MW-6, MW-7, and MW-19s. Because of the stringent discharge requirements set by the current NPDES permit, groundwater is temporarily stored in an above ground storage tank and periodically removed from the site by a vacuum truck for off-site disposal.

Through March 9, 2009, the SVE system has operated for 33,684 hours and has removed an estimated 6,698 pounds of hydrocarbons from the subsurface, and the GWE system has recovered approximately 209,398 gallons of groundwater.

Table 7 presents a summary of the remediation system performance data and Table 8 presents the individual well vapor analytical data. Graph 1 depicts the influent VOC concentrations over time, Graph 2 depicts the cumulative hydrocarbons and groundwater recovered over time, and Graph 3 depicts the percentage of system operation over time.

5.0 GEOLOGY AND HYDROGEOLOGY

5.1 Regional and Geologic Setting

The site is located approximately 2 miles northeast of the Pacific Ocean and about ½ mile from the Huntington Mesa on the western portion of the Coastal Plain of Los Angeles and Orange counties. The site is located on the western edge of the Downey Plain, a physiographic lowland of aggradational origin and Recent age (Poland, 1956). Surface expression along the coastal plain is relatively flat except for mesas and terraces of Pleistocene marine sediments that were uplifted by movement along faults of the Newport-Inglewood structural zone. In the subsurface, movements along the faults have displaced and folded Quaternary deposits (Barrows, 1974).

5.2 Site Lithology

Soil encountered during previous subsurface investigations at the site consists of clay, silty clay, clayey silt, silt, clayey sand, silty sand, and sand. From boring logs of over 50 soil borings, three distinct sediment sequences or units are apparent. The uppermost unit occurs from the ground surface to a depth of approximately 26 to 31 feet bgs and consists primarily of interbedded silt and clay with some fine-grained sand lenses. This upper unit is referred to herein as the silty clay unit. Underlying this upper section of fine-grained sediments is a sandy unit, ranging from fine to coarse grained with varying amounts of silt and minor amounts of clay. The sandy unit occurs from approximately 26 to 31 feet bgs and extends to approximately 45 to 50 feet bgs. This second unit is referred to herein as the silty sand unit. Beneath the silty sand unit, a third unit consisting of interbedded layers of clay, silty clay, and sandy clay occurs to a depth of at least 50 feet bgs (maximum depth explored). This

third unit is referred to herein as the clay unit. Geologic cross sections are presented as Figures 4 and 5. The locations of the sections are shown on Figure 3.

5.3 Regional Hydrogeology

The site is located within the Orange County Ground Water Basin. This basin is part of the Greater Los Angeles Basin Coastal Plain, which contains about 20,000 feet of marine and nonmarine sedimentary strata, the upper part of which are water bearing (DWR, 1967). Within the upper stratagraphic section, two major aquifers have been identified (DWR, 1967). They are the Talbert Aquifer, which occurs within approximately 200 feet of the surface, and the Main Aquifer, which generally occurs at elevations of -500 to -200 feet relative to mean sea level. The main recharge areas for the deep aquifers occur in the northern and eastern portions of the basin, termed the Forebays. In the southern and western portions of the basin, referred to as the Pressure areas, confined conditions prevail (Robbins, 1986). Overlying the deep aquifer zones is a shallow water zone occurring within recent alluvium and stream deposits. This zone is generally termed the “perched” or “semiperched” groundwater (Robbins, 1986).

The site is located within the Pressure subarea of the Orange County Ground Water Basin. The Pressure subarea is generally defined as the area of the basin where surface water and shallow groundwater are prevented from percolating in large quantities into the major producible aquifers by clay and silt layers at shallow depths. Piezometric head differentials of 50 to 100 feet are common between the shallow-most aquifers and the overlying production aquifers in the Pressure subarea. The production aquifers in the Pressure subarea, generally at depths between 300 and 1,500 feet, behave as confined with seasonal piezometric level fluctuations of several tens of feet between pumping and non-pumping conditions (Herndon, 1992).

The semiperched aquifer overlies much of the central and coastal portions of the Orange County Ground Water Basin. In many areas, the semiperched aquifer is composed primarily of low permeability clay and silt with intermittent sand lenses. The term “semiperched” is used to denote any shallow water-bearing zone, which, although underlain by fully-saturated sediments, is substantially hydraulically separated from underlying aquifers, as often indicated by large vertical piezometric head differentials. Groundwater flow in the semiperched aquifers throughout the basin tends to be site specific and often controlled by localized surficial recharge sources, such as over-irrigation areas, or unlined drainage channels that intersect the shallow water table (Herndon, 1992).

5.4 Site Hydrogeology

Groundwater beneath the site occurs under confined conditions in the silty sand unit encountered at a depth of approximately 30 feet bgs and equilibrates to a static level at a depth of approximately 15 to 20 feet bgs under artesian conditions (hydrostatic head). The upper fine soils layer, composed of silty clay, is referred to herein as the confining layer, and groundwater contained in the confining layer is referred to as the upper water-bearing zone. The underlain sandy layer, composed of silty sand, is referred to herein as the confined aquifer, and groundwater contained in the confined aquifer is referred to as the lower water-bearing zone. Depth to water encountered during the January 2009 drilling activities and subsurface lithology are shown on cross sections A-A' and B-B, presented as Figures 4 and 5, respectively.

Historically, static depth to groundwater in monitoring wells has fluctuated from approximately 10 to 25 feet bgs. Typically, depth to groundwater fluctuates approximately 2 to 4 feet annually. Historically, static groundwater elevation has ranged from approximately 0 to 15 feet above mean sea level (amsl). Based on the most recent groundwater monitoring data collected on February 6, 2009, during the first quarter 2009 monitoring event, groundwater beneath the site occurs at an elevation of approximately 4 to 6 feet amsl. The direction of groundwater flow beneath the site in both the upper and lower water-bearing zones is variable. Historical Groundwater elevation and gauging data are presented in Table 3. Groundwater elevations in the upper and lower water-bearing zones are shown on Figures 6 and 7, respectively.

6.0 WELL/CONDUIT STUDY

6.1 Production Well Information

According to data supplied to ARCO by the Orange County Water District (OCWD) in November 2000, five public water supply wells are located within a ½-mile radius of the site. The following table summarizes information regarding the five wells.

Well Name	State Well Identification	Well Owner	Location (from Site)	Well Status	Water Use	Total Depth	Screen Interval
OVSC-HB	05S/11W-24N07	Ocean View School District	880 ft SE	Active	AG/IR[1]	244 ft.	180-216 ft
SCE-HBOV	05S/11W-24N02	Southern California Edison	1260 ft SE	Active	AG/IR[1]	Unknown	Unknown
OVWC-HB	05S/11W-25D02	Ocean View Mutual Water Co.	1320 ft SE	Active	SMSYS[2]	180 ft.	Unknown
FURU-HB	05S/11W-26B14	Raymond H Furuta	2750 ft. SW	Active	Domestic	150 ft.	Unknown
HB-3A	05S/11W-26A03	City of Huntington Beach	2000 ft. SW	Active[4]	LGSYS[3]	660 ft.	370-640 ft.

[1] = agriculture and irrigation
[2] = small system
[3] = large system
[4] = personal communication with Steven Sharp (OCHCA) indicating well HB-3A is currently active.

6.2 Pipelines and Utilities

The site was formerly connected to sewer, water, telephone, electricity, and natural gas utilities. Due to the fluctuating depth to groundwater beneath the site (10 to 25 feet bgs), it is possible that

underground utility trenches could occasionally act as a conduit for the transport of petroleum hydrocarbon-impacted groundwater. However, groundwater levels are typically below 12 feet bgs and below most utility trenches. In addition, utility trenches could provide a conduit for hydrocarbon vapor transport. Several underground utilities have been identified beneath Beach Boulevard and Terry Drive in the vicinity of the site. These utilities include a 24-inch diameter storm drain, a 30-inch diameter storm drain, 8-inch and 10-inch diameter vitrified clay pipe sewer lines, and an 8-inch diameter water line. The locations of identified underground utilities in the site vicinity are shown on Figure 8.

The 30-inch diameter storm drain is located beneath the right northbound lane of Beach Boulevard. A 24-inch diameter storm drain, located north of the site within Terry Drive, joins the 30-inch diameter drain at the southeast corner of the intersection. Storm water collected within the drains flows south beneath Beach Boulevard into the Ocean View Channel, located approximately 640 feet due south of the site. Ocean View Channel flows to the west into Wintersburg Channel and is tidally influenced.

The 10-inch diameter sewer line is located beneath the right southbound lane of Beach Boulevard and flows to the south. According to the City of Huntington Beach, this sewer line is located at a depth of approximately 14 feet bgs in the vicinity of the site. When this line reaches the Ocean View Channel, it is located approximately 19.8 feet bgs. This line ultimately intersects the main 69-inch diameter sewer trunk located within Warner Avenue, located approximately 1800 feet south of the site. The 8-inch diameter sewer line, located north of the site within Terry Drive, is located at a depth of about 4 feet bgs. Due the seasonal shallow depth to water in the site vicinity, it is possible that the backfill material surrounding the 10-inch Beach Boulevard sewer line may intersect the water table during periods of high groundwater levels.

7.0 REMEDIATION PROGRESS ASSESSMENT

7.1 Soil Borings Advancement and Sampling

Prior to the initiation of the field activities, the proposed boring locations were marked, Underground Service Alert was notified, and a well construction permit was obtained from the OCHCA (Appendix B). In addition, on January 12, 2009, Pacific Coast Locators, a private utility locating company contracted by Delta, was on site to locate underground utilities beneath the site.

Cascade Drilling of La Habra, California, was contracted by Delta to provide the necessary equipment and personnel to conduct the field activities under the supervision of Delta. On

January 13, 2009, the initial five feet of the soil borings were cleared using a truck-mounted air-knife/vacuum rig (air knife) in order to reduce the possibility of damaging unidentified underground utilities.

On January 14 and 15, 2009, Delta personnel were on-site to oversee the advancement of soil borings at seven locations (B-37 through B-44). At each location a continuous soil boring was advanced past the initial five feet using a truck mounted direct-push rig. The locations of the soil borings are presented on Figures 2 at 3. Soil borings B-37 through B-39 and B-41 through B-43 were advanced vertically to a depth of 35 feet bgs, soil boring B-40 was advanced vertically to a depth of 30 feet bgs,. Upon reaching the total depth, the borings were backfilled with bentonite grout and resurfaced to grade with concrete.

All the soil borings were continuously logged for lithological description using a disposable acetate liner inside of the direct-push rods, and soil samples for laboratory analysis were obtain from each boring at five-foot intervals from approximately 5 to 35 feet bgs (5 to 30 feet bgs for boring B-40). Prior to initiating the sampling, and between each sample run, the sampler was washed with Liquinox solution, followed by a two-stage rinse. Soil samples were collected by cutting a section, approximately 6-inch long, of the acetate liner. Each sample was labeled, placed in a re-sealable plastic bag, and stored in an ice-chilled cooler pending delivery to the analytical laboratory. The soil remaining in the acetate liner next to where the samples were collected was screened in the field for volatile organic compounds (VOCs) using a photo-ionization detector (PID). Soil classifications, PID screening results, and other soil sampling data are presented on the boring logs provided in Appendix C.

7.2 Waste Containment and Disposal

All soil cuttings and decontamination water generated during the assessment activities were placed in Department of Transportation-approved, 55-gallon, metal drums, labeled, and temporarily stored onsite pending proper disposal. Upon receipt of soil analytical results, the soil drums were transported by Belshire Environmental Services to TPS Technologies Facility in Adelanto, California, and the water was transported to DeMenno Kerdoon in Compton, California. Waste disposal manifests are provided in Appendix D.

7.3 Soil Sample Analyses

Soil samples collected from soil borings B-37 through B-43 were submitted to Test America, a California Department of Health Services approved analytical laboratory located in Irvine, California.

Strict chain-of-custody procedures were followed from the time the samples were collected until the time the samples were delivered to the laboratory. The soil samples collected were analyzed for gasoline range organics (C6-C12) (GRO) according to EPA Method 8015 Modified and for benzene, toluene, ethylbenzene, total xylenes (BTEX collectively), MTBE, TBA, di-isopropyl ether (DIPE), ethyl tertiary butyl ether (ETBE), tertiary amyl methyl ether (TAME), ethanol, and additional VOCs according to EPA Method 8260B full scan.

7.4 Soil Sample Analytical Results

Historical soil analytical results are presented in Table 1, the laboratory reports and chain-of-custody documentation are provided as Appendix D. Laboratory analytical results for the soil samples collected from confirmation soil borings B-37 through B-43 indicate that:

- GRO and BTEX constituents were detected in every boring, The highest concentrations of GRO and benzene (17,000 and 52 mg/kg, respectively) were detected in the sample collected at 30 feet bgs from boring B-43, located in the middle of the southern portion of the site.

- MTBE was detected eight of the 48 samples analyzed. The eight samples that contained MTBE were collected from borings B-37 and B-39 through B-42. MTBE was not detected in borings B-38 and B-43. The maximum concentration of MTBE (12 mg/kg) was detected in the sample collected at 25 feet bgs from boring B-42, located in the northwest portion of the site, within the former USTs that were removed in 2001.

- TBA was detected in only three of the 48 samples analyzed. TBA was detected, at concentrations of 57 and 28 mg/kg, in the samples collected from boring B-37 at depths of 20 and 25 feet bgs, respectively, and at a concentration of 1.2 mg/kg in the sample collected at a depth of 30 feet bgs from boring B-40. Borings B-37 and B-40 are located within the former western dispenser island and the former USTs that removed in 1989, respectively. TBA was not detected in the samples collected from borings B-38, B-39, and B-41 through B-43.

- DIPE, ETBE, and TAME were not detected, at or above the laboratory reporting limits, in any of the soil samples.

8.0 EXTENT OF IMPACTED SOIL AND GROUNDWATER

8.1 Release Scenario

Soils sample analytical results presented in Table 1 indicate that three separate sources contributed to the release of gasoline fuel to the subsurface, and that the released gasoline spread laterally a significant distance as it migrated downward. This patter is typical of tight soils and is shown in the schematic cross section presented in Figure 9. The extent and concentrations of the hydrocarbons associated with the three separately identified releases are described below:

1. A larger release occurred at the location of the former USTs that were removed in 1989. Soil samples collected on April 4, 1989, from the bottom of the UST cavity at a depth of 15 feet bgs contained TPH-g and benzene at maximum concentrations of 12,582 and 63,5 mg/kg, respectively (S-15-T3W). In addition, borehole MW-7, drilled on August 22, 1989, within the location of the former USTs, contained fuel hydrocarbons all the way to the bottom of the borehole (25 feet bgs), with maximum concentrations of TPH-g and benzene of 398 and 13.9 mg/kg, respectively, detected in the sample collected from 15 feet bgs. Borehole MW-11, drilled on April 13, 1990, immediately south of the former USTs, contained fuel hydrocarbons to the maximum depth sampled (22 feet bgs) with the highest concentrations of TPH-g and benzene, 819 and 10 mg/kg, respectively, detected in the sample collected from 22 feet bgs.

2. A smaller release occurred at the location of the former USTs that were removed in 2001. Soil samples collected on October 31, 2001, from the bottom of the UST cavity at a depth of 17 feet bgs contained TPH-g and benzene at maximum concentrations of 1,200 and 1.9 mg/kg, respectively (T2-B1). In addition, borehole MW-10, drilled on April 13, 1990, to the southwest of the former USTs, contained fuel hydrocarbons to the maximum depth sampled (20 feet bgs), with the highest concentrations of TPH-g and benzene, 521 and 11 mg/kg, respectively, detected in the sample collected from 20 feet bgs. Borehole B-21, drilled on July 31, 1991, immediately south of the former USTs, contained fuel hydrocarbons to the maximum depth sampled (18.5 feet bgs), with the highest concentrations of TPH-g and benzene, 1,200 and 14 mg/kg, respectively, detected in the sample collected from 18.5 feet bgs.

3. A fairly substantial release occurred at the location of the former western dispenser island. Soil samples collected at a depth of four feet bgs from beneath the former dispensers on October 31, 2001, did not contained detectible concentrations of TPH-g or BTEX

constituents, but did contain low concentrations of MTBE (the maximum MTBE, 1.2 mg/kg, was detected in sample D5). However, elevated concentrations of TPH-g and BTEX constituents were detected in the samples collected from boreholes MW-12, B-30, and B-31 drilled just south of the western dispenser island. Borehole MW-12, drilled on July 31, 1991, contained fuel hydrocarbons to the maximum depth sampled (24.5 feet bgs), with the highest concentrations of TPH-g and benzene, 6,800 and 20 mg/kg, respectively, detected in the sample collected from 6.5 feet bgs. Borehole B-30, drilled on February 29, 2000, contained fuel hydrocarbons to the maximum depth sampled (35 feet bgs), with the highest concentrations of TPH-g and benzene, 6,800 and 20 mg/kg, respectively, detected in the samples collected from 5 and 15 feet bgs, respectively. Borehole B-31, drilled on September 11, 2001, contained fuel hydrocarbons to a depth of 31 feet bgs, with the maximum concentrations of TPH-g and benzene, 8,700 and 37 mg/kg, respectively, detected in the samples collected from 31 feet bgs, respectively; however, TPH-g and benzene were not detected in the samples collected at 35, 40, and 45 feet bgs, from borehole B-31.

8.2 Extent of Impacted Soil

Soil sample analytical results reveal that hydrocarbons beneath the site are present in the form of GRO and BTEX constituents within the silty clay unit indentified between ground surface and approximately 30 feet bgs (Figures 4, 5, and 9). Historical and recently acquired soil analytical data indicate that contamination does not exist within the silty sand unit (confined aquifer), except for the sample collected at a depth of 35 feet bgs from borehole B-30 (Table 1). Hydrocarbons did not migrate deeper than the wet fine material directly above the aquifer likely due to the hydrostatic head created by the confined aquifer, preventing deeper migration of hydrocarbons (Figure 10). Recent data (borings B-37 through B-43, Table 1) indicate that if any contamination did make it into the sand of the confined in the past, it has been attenuated already (Figure 4 and 5).

In addition, recently acquired soil analytical data indicate that the upper part of the soil contamination has been attenuated by one or more of the following processes:

- Washing by infiltrated surface water (precipitation and irrigation)
- Volatilization (both natural and induced by VE system)
- Aerobic Biodegradation where O2 supply is sufficient

Current hydrocarbon concentrations are higher between 20 and 30 feet bgs, and in four of the seven recently sampled progress borings (B-37, B-38, B-42, and B-43) are the highest in the samples collected at 30-foot bgs, within the capillary fringe. The samples collected at the bottom of the borings within the silty sand unit, at a depth of 35 feet bgs, contained non detectable or very low concentrations of petroleum hydrocarbons, typically multiple orders of magnitude lower than the concentrations detected in the 30-foot samples collected within the fine soils of the capillary fringe.

The concepts described above are schematically illustrated in the cross section of hydrocarbon distribution and the site conceptual diagram shown in Figures 9 and 10, respectively. Soil sample analytical results are presented in Table 1 and shown on cross sections A-A' and B-B', presented in Figures 4 and 5, respectively.

Based on the data presented above it is Delta's opinion that the extent of hydrocarbons impacted soil has been adequately delineated both horizontally and vertically and that no further soil assessment is warranted at the site.

8.3 Groundwater Occurrence and Extent of Impacted Groundwater

Groundwater monitoring activities have been conducted at the site on a quarterly basis since May 1990. ARCO is currently monitoring a total of 17 groundwater monitoring wells, 13 on-site and 4 off-site. These wells are discreetly screened at different depths to monitor groundwater in the silty clay confining layer (upper zone) and in the silty sand confining aquifer (lower zone). Of the 12 monitoring wells completed in the upper zone, screened from depths of 5 to 15 feet bgs to a depth of 25 feet bgs, 9 are on site (MW-2, MW-3, MW-6, MW-7, MW-19s, MW-20s, B-36, BC-3, and BC-4) and 3 are off site (MW-17, BC-1 and BC-2). Of the 5 monitoring wells completed in the lower zone, screened from depths of 27 to 40 feet bgs to depths of 44 to 47 feet bgs, 4 are on site (MW-10R, MW-11, MW-19d, and MW-20d) and 1 is off site (MW-18). Groundwater monitoring well construction details are summarized in Table 2, and historical groundwater analytical results are presented in Tables 4 and 5.

8.3.1 Groundwater Occurrence

The logs for soil boring B-37 through B-43 (Appendix C) indicate that the borings were mostly dry to at depth of approximately 30 feet bgs and that groundwater was encountered at approximately 30 ft bgs in all the borings, which is where the confined aquifer composed of silty sand is also encountered. Groundwater gauging indicates substantial hydrostatic head on the confined aquifer. Depth to water recently is approximately 16 top 19 feet bgs; therefore,

approximately 11 to 13 feet of hydrostatic head must be accounted for. The well construction details presented in Table 2 indicate that in the past the wells were screened from the sand aquifer into the shallower confining soil, which probably provided conduits. This condition was not rectified until 2002, when the wells broadly screened across the confining layer and the confined sandy aquifer were destroyed and replaced by wells discretely screened in either of the two water-bearing zones. Although, some “perched” water exists due to infiltration of precipitation and irrigation, as well as other possible sources (storm drains, sewers, etc.), it is Delta’s opinion that there is no “perched aquifer” beneath the site, as previously believed, but rather some of the water from the sand aquifer historically flowed into the more permeable layers (sand lenses) within the shallow fine soil through the former broadly screened wells that have been destroyed. This theory is validated by the inability of the GWE system currently operating at the site to effectively pump groundwater from the upper water-bearing zone (only a few hundred gallons per week are recovered). Further, this groundwater model explains the lack of lateral migration of the fuel hydrocarbons plume in the upper water-bearing zone, despite the concentrations detected beneath the western half of the site.

8.3.2 Dissolved Hydrocarbons in the Upper Groundwater Zone

Groundwater analytical results for the samples collected on February 6, 2009, during the first quarter 2009 groundwater monitoring event, from the wells discretely screened in the upper water-bearing zone indicate that dissolved hydrocarbons were not detected in any of the off-site wells, with the exception of dissolved benzene and ethylbenzene, detected at concentrations of 0.51 and 0.52 μg/L, respectively, in off-site well BC-2. On site dissolved hydrocarbons were detected in wells MW-3, MW-6, MW-7, B-36, and BC-3. The maximum dissolved GRO, benzene, and MTBE concentrations (45,000, 12,000, and 7,500 μg/L, respectively) were detected in well BC-3, located in the central portion of the site, between the two locations of the former USTs. The maximum concentration of dissolved TBA (24,000 μg/L) was detected in well MW-6, located in the western portion of the site, between the former USTs removed in 2001 and the former western dispenser island.

Historical groundwater analytical results are presented in Tables 4 and 5, and current groundwater monitoring data are presented in Table 9 and on Figure 6. Dissolved GRO, benzene, MTBE, and TBA isoconcentration maps are shown on Figures 11 through 14, respectively.

8.3.3 Dissolved Hydrocarbons in the Lower Groundwater Zone

During the first quarter 2009 groundwater monitoring event, on February 6, 2009, the groundwater analytical results for the samples collected from the wells discretely screened in the lower water-bearing zone, indicate that dissolved hydrocarbons were not detected in the four on-site and the one off-site wells used to monitor the sand aquifer. Historical groundwater analytical results indicate that dissolved hydrocarbons have not been detected in off site well MW-18 since August 2004 and in any of the four on-site wells since July 2005.

Historical groundwater analytical results are presented in Tables 4 and 5, and current groundwater monitoring data are presented in Table 9 and on Figure 7.

Based on the data presented above, it is Delta's opinion that the extent of dissolved hydrocarbons plume has been adequately delineated both horizontally and vertically and that no further groundwater assessment is warranted at the site.

9.0 SITE CONCEPTUAL MODEL SUMMARY

Below is a summary of the site lithology and hydrogeology, and the extent of the hydrocarbon impact and its remediation:

- Three distinct sediment sequences or units are identified beneath the site (Figures 4 and 5).
  1. The silty clay unit occurs from the ground surface to a depth of approximately 26 to 31 feet bgs. This unit acts hydrogeologically as a confining layer and is referred to as the upper water-bearing zone.
  2. The silty sandy unit occurs from approximately 26 to 31 feet bgs and extends to approximately 45 to 50 feet bgs. This unit behaves hydrogeologically as a confined aquifer and is referred to as the lower water-bearing zone.
  3. Beneath the sandy unit, a clay unit occurs to a depth of at least 50 feet bgs (maximum depth explored).

- Although some "perched" water exists due to infiltration of precipitation and irrigation, as well as other possible sources (storm drains, sewers, etc.), there is no "perched aquifer" beneath the site.

- The confined aquifer is under substantial hydrostatic head (11 to 13 feet).

- Three separate sources contributed to the release of gasoline fuel to the subsurface. The released gasoline spread laterally a significant distance as it migrated downward (Figure 9), which is typical of fine soils.

- The upper part of the hydrocarbon impacted soil has been attenuated by one or more natural and/or induced processes.

- Soil within the sandy unit (confined aquifer) is not impacted. Hydrocarbons did not migrate deeper than the fine soils of the confining layer directly above the aquifer, likely due to the hydrostatic head created by the confined aquifer, preventing deeper migration of hydrocarbons (Figure 10). If any hydrocarbons did make it into the aquifer sand in the past, it has been attenuated already.

- At the farthest reaches, the contamination is spread vertically over at least 5 feet (Figures 9).

- Dissolved hydrocarbons in the upper water-bearing zone are limited to within the property boundary, except for dissolved TBA, which extends beyond the property boundary to the west (Figures 6, and 11 through 14).

- The lower water-bearing zone is not impacted by dissolved hydrocarbons (Figure 7).

- The site has been under active remediation by SVE and/or GWE since March 1997, and a DPE system is currently operating at the site. Through March 9, 2009, the SVE system has operated for 33,684 hours and has removed an estimated 6,698 pounds of hydrocarbons from the subsurface, and the GWE system has recovered approximately 209,398 gallons of groundwater.

10.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information presented in this document, the following conclusions are provided:

- The extent of hydrocarbon impacted soil and groundwater beneath the site are defined both laterally and vertically.

- The dissolved hydrocarbon plume identified in the upper water-bearing zone (confining layer) has hardly migrated any distance laterally, due to the fine and tight nature of the soil of which it is composed. Further, it has not migrated vertically to impact the lower water-bearing zone (confined aquifer), due to the hydrostatic head created by the confined aquifer.

- Hydrocarbon impacted soil in the upper portion of the silty clay unit has, for the most part, been remediated and/or has attenuated. However, analytical results for the January 2009 progress assessment indicate that hydrocarbon impacted soil still exist within the silty clay unit at depths between 20 and 30 feet bgs, and particularly within the capillary fringe occurring between 25 and 30 feet bgs.

- The currently operating DPE system has remediated the site to the extent feasible. Do to the nature of the fine and tight soil present in the top 30 feet beneath the site the remedial system can no longer cost effectively remediate the hydrocarbon impacted soil and groundwater indentified during the January 2009 progress assessment and the February 2009 groundwater monitoring event, respectively, by means of SVE and GWE.

Based on the conclusions presented above, the following recommendations are provided:

- Shutdown operations of the DPE system and implement an alternative technology, such as in-situ chemical oxidation (ISCO), to remediate the hydrocarbon impacted soil and groundwater remaining beneath the site.

- Complete the on-going ISCO laboratory bench testing to evaluate the use of sodium persulfate as an in situ chemical oxidant to mineralize GRO, BTEX constituents, and fuel oxygenates that have impacted soil and groundwater. Interim data and conclusions are presented below.

- Conduct field pilot test to confirm the results of the laboratory bench test.

11.0 REVISED CORRECTIVE ACTION PLAN

This section describes the approach, scope of work, and interim bench testing results for the implementation of the ISCO remedial technology recommended above.

11.1 In Situ Chemical Oxidation Overview

ISCO has been successfully employed to mineralize a wide range of contaminants in soil and groundwater. Several oxidants, including hydrogen peroxide (modified Fenton's approach), ozone, permanganate and persulfate have been demonstrated to be effective and capable of mineralizing GRO, BTEX constituents, and fuel oxygenates (the target hydrocarbons). A laboratory bench test is typically the first step in the oxidant selection process. Soil and groundwater samples from a site are used to select the oxidant that can achieve the greatest contaminant mass reduction given the site specific soil and groundwater conditions.

11.2 Laboratory Bench Test

A bench test is underway that will evaluate whether activated sodium persulfate (ASP) can oxidize the target hydrocarbons in the soil and groundwater beneath the site. The initial results indicate that sodium persulfate can oxidize the target hydrocarbons. Additional testing is ongoing to determine the most effective activator for sodium persulfate, given the specific characteristics of the soils and groundwater. The activators being evaluated are alkaline activated sodium persulfate and persulfate activated primarily by calcium peroxide (Klozur CR®).

Based on the results of the bench testing the remedial design is in progress to use ASP to oxidize and mineralize the hydrocarbons remaining beneath the site. A full-scale remedial work plan will be developed based on the results of the field pilot test. The full-scale ASP injection approach will be used to target the GRO, BTEX constituents, and fuel oxygenates that are concentrated in the soil between approximately 20 to 30 feet bgs.

11.2.1 Soil and Groundwater Sample Collection

Soil samples collected from progress borings B-37 through B-43 on January 14 and 15, 2009, along with the groundwater samples collected from existing monitoring wells using low-flow sampling methods on March 05, 2009, were sent to Prima Environmental Laboratory, Inc. (Prima) in Sacramento, California for the bench-scale testing.

11.2.2 Preliminary Sample Characterization

Prior to conducting the bench-scale testing, the field soil samples were homogenized and particles > 4 mesh were removed. Homogenized soil was analyzed for:

- GRO
- BTEX
- MTBE
- Hexavalent chromium (CrVI)
- Total chromium
- Total organic carbon (TOC)

The groundwater samples that were received in multiple containers were composited prior to testing, then analyzed for:

- GRO
- BTEX
- MTBE
- CrVI
- Dissolved chromium
- Oxidation reduction potential (ORP)
- pH
- Sulfate
- TOC

11.2.3 Soil Oxidant Demand

The activated persulfate soil oxidant demand (SOD) was measured. For each activator, two series of reactors (3 reactors per series) were prepared. Soil, groundwater and activated persulfate were combined such that the soil to liquid ratio was 1:3. The concentrations of persulfate were determined in part based on the concentrations of target hydrocarbons and therefore are different in each series. The pH was adjusted using sodium hydroxide (NaOH); the amount of NaOH needed was equal to ½ the maximum amount of acid that can be generated by the persulfate. The replicates were analyzed at 2, 4, and 7 days. One replicate from each series was destructively sampled and analyzed for residual persulfate. The initial data indicate that the SOD is within acceptable ranges.

11.2.4 Buffering Curves

Buffering curves have been developed to determine how soil neutralizes the high pH associated with alkaline activated persulfate. Soil and dilute sodium hydroxide was combined in a 1:1 liquid to soil ratio. Three concentrations were used, ranging from pH 11 to pH 14. The pH was measured periodically for up to 14 days. The interim data indicate that the soil has the capacity to buffer the high pH associated with the ASP.

11.2.5 Target Hydrocarbon Removal – Dissolved Phase

Batch tests are underway to assess target hydrocarbons removal using two activators: high pH (pH > 11) and Klozur CR® (solid peroxide activation). Seven reactors containing soil, groundwater (no sheen or NAPL), and activated persulfate in a 1:5 soil to liquid ratio were prepared. Controls and the Time 0 reactor used deionized water in place of activated persulfate. Off-gases were collected from the Klozur tests. After mixing for 60 minutes, the Time 0 reactor was destructively sampled and the aqueous phase analyzed for the target hydrocarbons. Periodically, one control reactor and one test reactor of each activator were destructively sampled and the aqueous phases analyzed for the target hydrocarbons and secondary parameters. Off-gases were also analyzed for the target hydrocarbons.

The effect of dissolved-phase treatment on secondary water quality is being evaluated for:

- Cr(VI)
- Dissolved chromium
- ORP
- pH
- Residual persulfate
- Sulfate

The interim data for the Time 0 and Time 7 have been completed. The interim data are shown in the table below.

Analyte	Units	AP-Time 0	Control		AP-pH		Klozur CR®	
			7 d	24 d	7 d	24 d	7 d	24 d
		Aqueous Phase Concentration						
GRO*	mg/L	17	18	pending	1.0	pending	0.35	pending
Benzene	µg/L	2,600	1,400		230		26	
Toluene	µg/L	68	16		< 1.0		< 0.50	
Ethylbenzene	µg/L	71	17		< 1.0		< 0.50	
m,p-Xylene	µg/L	1,200	1,400		3.8		< 0.50	
o-Xylene	µg/L	320	430		2.3		< 0.50	
MTBE	µg/L	2,200	2,300		710		320	
Volume	L	1.0	1.0	1.0	1.0	1.0	0.9	0.9
		Off-Gas Concentration						
GRO	mg/L	n.a.	n.a.	n.a.	n.a.	n.a.	0.14	pending
Benzene	µg/L	n.a.	n.a.	n.a.	n.a.	n.a.	6.5	
Toluene	µg/L	n.a.	n.a.	n.a.	n.a.	n.a.	< 0.15	
Ethylbenzene	µg/L	n.a.	n.a.	n.a.	n.a.	n.a.	< 0.15	
m,p-Xylene	µg/L	n.a.	n.a.	n.a.	n.a.	n.a.	< 0.15	
o-Xylene	µg/L	n.a.	n.a.	n.a.	n.a.	n.a.	< 0.15	
MTBE	µg/L	n.a.	n.a.	n.a.	n.a.	n.a.	< 0.15	
Volume	L	n.a.	n.a.	n.a.	n.a.	n.a.	0.35	

*The GRO concentration does not include the MTBE concentration. MTBE concentration subtracted out

The interim data show significant reductions of target hydrocarbons using both activators. The percent concentration reduction in the high pH activated persulfate was 68% for MTBE, 91% for benzene, 95% for GRO, and greater than 99% for toluene, ethylbenzene, and m,p-xylene. The percent concentration reductions were slightly higher for the Klozur CR® activated with calcium peroxide, with reductions of 85% for MTBE and greater than 98% for GRO and BTEX constituents. The data indicate that the persulfate reactions using both activators were rapid and nearing completion after only seven days of exposure of the target hydrocarbons to the oxidant solution. These interim results would seem to indicate that the persulfate reacts faster with the site soils than typically observed at other sites with similar conditions and that there was nearly complete mineralization of the target hydrocarbons.

Based on the interim results, persulfate oxidation of the target hydrocarbons is a feasible remedial approach for the site.

11.3 Remedial Design and Work Plan

The final results of the bench scale testing will be incorporated into the on-going design effort to finalize the ISCO field pilot test approach for the site. The design will determine the ASP injection strategy, the oxidant and activator concentration specifications, dosing requirements, injection method and procedures, injection point layout, injection intervals, and duration of persulfate injection treatment. Once the design criteria and strategy have been finalized, a field pilot test will be conducted with the OCHCA approval. The results of the field pilot test will be used to finalize the full-scale corrective action plan for the site.

12.0 SCHEDULE

Shortly after your review of this CAP, BP would like to schedule a meeting to discuss the contents of this proposal.

Upon your concurrence a Pilot Test Work Plan including the final bench testing results will be provided for your review within 45 days.

13.0 REMARKS

The recommendations contained in this report represent Delta's professional opinions based upon the currently available information and are determined in accordance with currently acceptable professional standards. This report is based upon a specific scope of work requested by the client. The Contract between Delta and its client outlines the scope of work, and only those tasks specifically authorized by that contract or outlined in this report were performed. This report is intended only for the use of Delta's Client and anyone else specifically listed on this report. Delta will not and cannot be liable for unauthorized reliance by any other third party. Other than as contained in this paragraph, Delta makes no express or implied warranty as to the contents of this report.

If you have questions or comments regarding this correspondence, please contact Mr. Darrell Fah of Atlantic Richfield Company at (714) 670-5228.

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